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Phytotoxicology Vegetation Assessment Survey in the Vicinity of Canada Brick, Burlington - August 1991

Introduction

On August 26, 1991, a vegetation assessment survey was conducted by Phytotoxicology staff in the vicinity of Canada Brick (CB), Burlington, to determine the effects of fluoride emissions on surrounding vegetation. Previous surveys also were conducted in 1990, 1989, 1987 and 1986. Previous surveys have shown that CB emissions of fluoride have increased since expansion of the brick production facilities in late 1986 through mid-1987. The surveys were requested by the MOE Central Region.

The east and north boundaries of CB lie adjacent to the Bronte Creek Valley. The west boundary borders CNR tracks and is neighboured to the immediate west by scrub land and commercial/industrial properties. Neighbouring the southern boundary were commercial and residential properties abutting on Dundas St. (see figure).

Sampling and Injury Assessment

On August 26, 1991, tree foliage was collected from exposed middle branches at the same sites that were sampled in previous years both close to CB (Sites 1 to 7 & 12) and more remote (8, 9, 11, 14, 15 & 16). At each site, duplicate foliage samples were collected using standard sampling procedures. All sites, except Sites 1, 2 and 3, were situated off company property (see figure).

In addition, foliage of trees and other vegetation growing in the vicinity of the collection sites, was inspected for fluoride injury.

The samples were returned to the Phytotoxicology Section Processing Laboratory. Here, the samples were processed on an unwashed basis, with exception of the samples from Sites 3, 5, 6 and 12, which were processed on a washed and unwashed basis. The foliage samples were oven dried, ground and stored in glass jars. They were then submitted to the MOE Laboratory Services Branch for fluoride analysis.

Analytical Results

Table 1 summarizes the 1986 through 1991 August fluoride results. The tree foliage results in 1991, as in previous years, displayed a decreasing fluoride concentration pattern with increasing distance from the company. The highest fluoride levels of 285 ppm (Site 7) and 210 ppm (Site 2, on CB land) were detected near the company's west

and east boundaries. In the residential area along the south side of Dundas St., fluoride levels in maple foliage were lower (in the range of 61 to 135 ppm, Sites 4, 5, 6, 12).

All sites, except more remote Sites 9 and 14, had fluoride concentrations that exceeded the 15 ppm Phytotoxicology Section Upper Limit of Normal (ULN) rural guideline. The highest foliar levels (285 & 210 ppm) were 18 and 13 times higher than the guideline.

On average, the foliar fluoride concentrations were marginally higher than in 1990. Fluoride values decreased overall between 1990 and 1991 if the apple foliage at Site 7 is excluded. The fluoride value at Site 7 was low in 1990 (with respect to the overall trend) and a return to typical concentrations gives the appearance of an increase in 1991. The mean foliar fluoride concentration for the common collection sites close to CB was marginally lower in 1991 compared to 1987 and 1989.

Table 2 shows that the particulate removal values (percent particulate fluoride washed from the foliage samples) for Sites 3, 5, 6 and 12 (range 22 to 49%) also were marginally increased at all but one of these sites in 1991 compared to 1990. The table shows that the particulate removal values are highly variable between sites and years (1986-1991) and that the 1991 results, for the most part, were not markedly different from the previous years' data.

Injury Assessment Findings

Inspections of vegetation in 1991 revealed that wild grape was the species most severely and extensively injured by fluoride emissions in the survey area. Wild grape is one of the most sensitive plant species to fluoride. The wild grape plants most adversely affected were growing in the vicinity of Sites 1, 2 and 3 (on company property), just east of CB, and exhibited moderate (11-35%) injury overall. Wild grape plants near Site 4 (SE of CB), and near Sites 7 and 16 (W of CB), exhibited light (2-10%) to moderate injury overall. The grape plants inspected more remote from the company had trace (>0-1%) to very light injury. The severity of fluoride-type injury on wild grape plants in the immediate area of CB appeared to be increased slightly in 1991 compared to other years (e.g. 1989 and 1990).

Foliar inspections in 1991 also revealed trace to light injury typical of fluoride on current year's Eastern white pine needles in the vicinity of Site 1 (company property). The severity of injury on affected needles in this area was similar to that observed in 1990.

In 1991, the foliage collected from all maple sites, with few exceptions (Sites 3 & 16), had brownish or blackish necrosis at the leaf tips or margins. Similar injury was also observed in other years, with the injury being the most pronounced on sugar maple each year (Sites 1, 2, 8, 14). However, as remote maples had similar injury (an indication that fluoride emissions were not involved), it is suspected that, in most cases, droughty soil conditions (and/or weather scorch in the case of sugar maple) were largely responsible.

Boxelder borer insect attack on Manitoba maple can also produce foliar symptoms that mimick fluoride injury.

Inspections of vegetation species not noted above did not reveal any foliar injury attributable to fluoride emissions. This includes vegetation on residential properties on the south side of Dundas Street.

Summary

In summary, the 1991 survey around Canada Brick (CB), Burlington, revealed a marginal increase in foliar fluoride levels (on average) in the survey area compared to 1990, but foliar fluoride concentrations overall were marginally lower than 1987 and 1989. The inspections in 1991 also revealed a slight increase in fluoride injury on one of the most sensitive plant species (wild grape) near the east and west boundaries of the CB property. However, the observations in 1991 did not reveal any major change in the degree or extent of fluoride-type injury on vegetation in the survey area compared to other years (1987-1990). The most adverse effects, as in previous years, were confined to the immediate area of the company. Canada Brick remains a significant but localized source of fluoride.

Table 1: Average* Fluoride Concentration (ppm, dry wt.) in Unwashed Tree Foliage in the Area of Canada Brick (CB), Burlington: 1986-1991

Site No.	Distance (km) & Direction from CB	Foliage Type	Year				
			1986	1987	1989	1990	1991
Sites Neighbouring CB							
1**	350m NE	Sugar Maple	43	127	107	54	62
2**	280m E	Sugar Maple	87	219	200	240	210
3**	400m ESE	Silver Maple	70	229	160	248	140
4	550m ESE	Manitoba Maple	33	69	64	66	61
5	540m SE	Silver Maple	35	131	135	102	135
6	540m SE	Manitoba Maple	20	58	68	50	71
7	125m WSW	Apple	160	269	290	63	285
8	300m WSW	Sugar Maple	17	54	65	17	55
12	530m SE	Silver Maple	15	89	120	70	86
15	700m E	Manitoba Maple	23	32	26	53	20
16	380m WNW	Silver Maple	-	-	-	20	45
Mean of Common Collection Sites			50	128	124	96	113
Sites More Remote							
9	960m SSW	Manitoba Maple Silver Maple	8 -	9 -	9 -	7 11	9 10
11	960m SE	Silver Maple	12	13	26	13	31
14	1480m NNE	Sugar Maple	4	7	6	5	7
Rural Upper Limit of Normal			15				

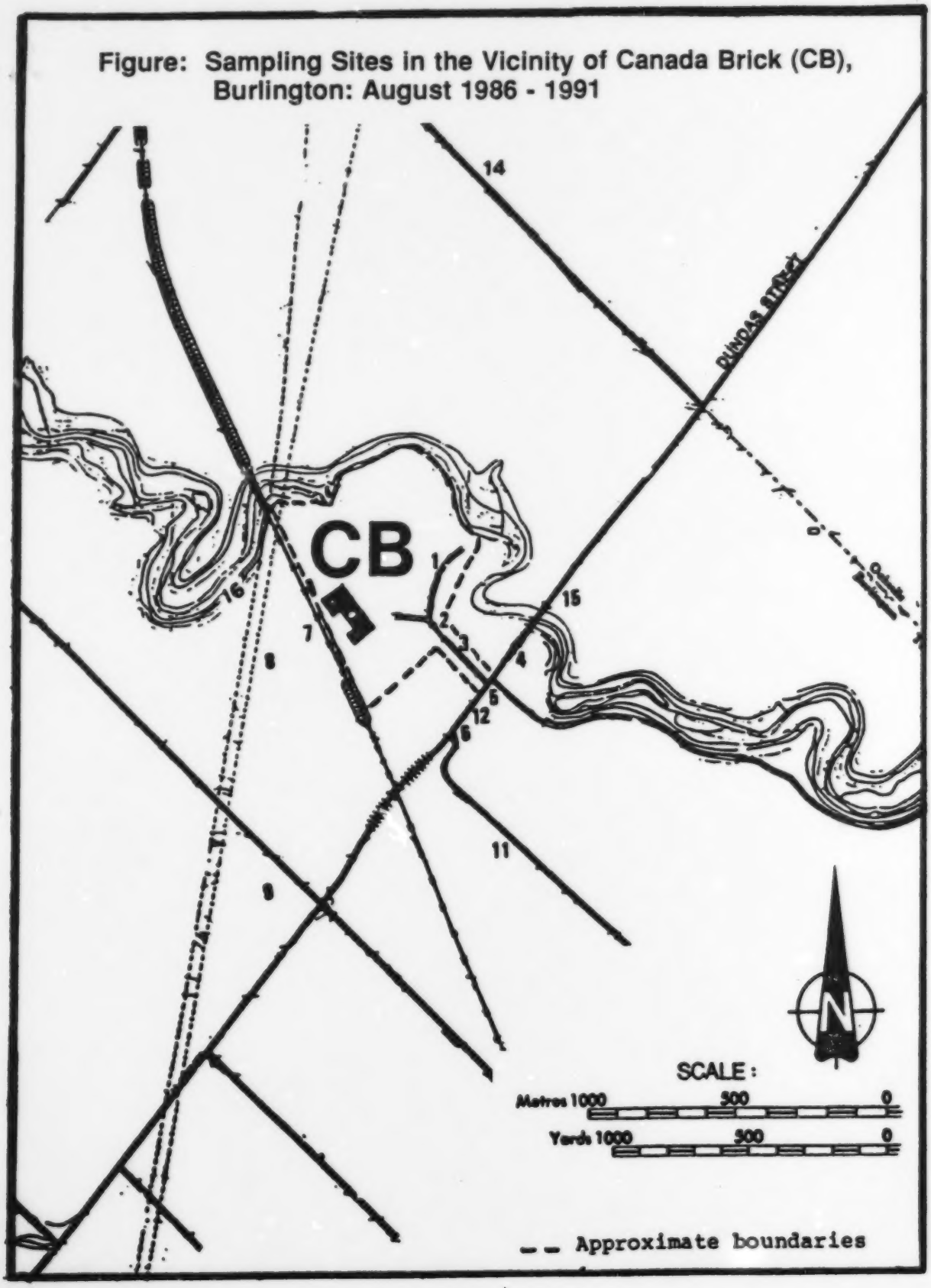
* Averages are based on duplicate sample results per site except at Sites 3, 5, 6 & 12 (4 samples/site) in 1990.
** Sites 1, 2 & 3 situated on company property

Table 2: Percent Fluoride Removal* from Washing of the Foliage Samples Collected for Washed Analysis in August: 1977-1991

Site No.	Distance (Km) & Direction from CB	Foliage Type	Percent (%) Removal				
			1986	1987	1989	1990	1991
Sites Neighbouring CB							
1	350m NE	Sugar Maple	-	21	31	-	-
2	280m E	Sugar Maple	49	24	46	20	-
3	400m ESE	Silver Maple	44	11	38	3	22
4	550m ESE	Manitoba Maple	35	0	48	-	-
5	540m SE	Silver Maple	18	17	36	26	28
6	540m SE	Manitoba Maple	20	25	60	32	49
7	125m WSW	Apple	17	17	36	-	-
8	300m WSW	Sugar Maple	0	41	52	-	-
12	530m SE	Silver Maple	-	0	62	30	29
15	700m E	Manitoba Maple	-	13	34	-	-
16	380m WNW	Silver Maple	-	-	-	-	-
Sites More Remote							
9	960m SSW	Manitoba Maple Silver Maple	0 -	25 -	33 -	- -	- -
11	960m SE	Silver Maple	-	42	15	-	-
14	1480m NNE	Sugar Maple	-	50	29	-	-

* Particulate removal values were calculated from the unwashed (NW) and washed (W) average fluoride levels using the formula $\frac{NW - W}{NW} \times 100$

Figure: Sampling Sites in the Vicinity of Canada Brick (CB), Burlington: August 1986 - 1991



Appendix

Derivation and Significance of the MOE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a point source of pollution. Urban ULN guidelines are based on samples collected from developed urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (ref: Ontario Ministry of the Environment 1983, *Phytotoxicology Field Investigation Manual*). Chemical analyses were conducted by the MOE Laboratory Services Branch.

The ULN is the arithmetic mean, plus three standard deviations of the mean, of the suitable background data. This represents 99% of the sample population. This means that for every 100 samples which have not been exposed to a point source of pollution, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.